

20. A device manufacturing method, including a process for transferring a device pattern onto a wafer by use of a projection exposure apparatus as recited in Claim 19.

REMARKS

Applicant requests favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

Claims 2-10, 12-17, 19 and 20 are presented for consideration. Claims 2 and 12 are independent. Claims 2-9, 12, 14-17 and 19 have been amended to clarify features of the subject invention, while claims 1 and 11 have been canceled without prejudice or disclaimer. Support for these changes can be found in the original application as filed. Therefore, no new matter has been added.

Applicant requests favorable reconsideration and withdrawal of the rejections set forth in the above-noted Office Action.

Claims 1-3, 7 and 8 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5,648,871 to Okuyama et al. Claims 6, 11-13, 16 and 17 were rejected under 35 U.S.C. § 103 as being unpatentable over the Okuyama et al. patent. Claims 1-17, 19 and 20 were rejected under 35 U.S.C. § 103 as being unpatentable over published European patent application number 0 660 169 (the "European document") in view of U.S. Patent No. 5,490,013 to Shimizu et al. Claims 11, 12, 16, 17, 19 and 20 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,148,036 to Matsugu et al. Applicant submits that the cited art, whether taken individually or in combination, does not teach many features of the present invention, as previously recited in claims 1-17, 19 and 20. Therefore, these rejections are respectfully

traversed. Nevertheless, Applicant submits that claims 2-10, 12-17, 19 and 20, as presented, amplify the distinctions between the present invention and the cited art.

In one aspect of the invention, independent claim 2 recites an aberration changing optical system for changing an aberration. The optical system includes an optical element having different refracting powers in two orthogonal directions or having a refracting power only in one direction, the optical element being rotatable about a rotational axis, which is an optical axis of the optical system, and being tiltable relative to the optical axis.

In another aspect of the invention, independent claim 12 recites a projection system for projecting a device pattern onto a wafer. The projection system includes a projection optical system disposed between the device pattern and the wafer and an optical element for correcting aberration produced in the projection optical system. The optical element has different refracting powers in two orthogonal directions or has a refracting power only in one direction. Also, the optical element is disposed between the device pattern and the wafer and is inclined with respect to an optical axis.

Applicant submits that the cited art, whether taken individually or in combination, does not teach such features of the present invention, as recited in independent claims 2 and 12.

The Okuyama et al. patent shows an aberration correcting optical system that is rotated about an axis, which is orthogonal to an optical axis, whereby it is tilted with respect to the optical axis. Applicant submits, therefore, that in the Okuyama et al. patent, the aberration correcting optical system is not rotated about the optical axis. Further, Applicant submits that that patent does not teach or suggest anything about rotating the aberration correcting optical system about the optical axis.

Applicant further submits that the combination of the European document and the Shimizu et al. patent does not teach or suggest the salient features of Applicant's present invention as recited in independent claims 2 and 12.

The European document discloses correction of astigmatism by use of a cylindrical lens, which is not tiltable with respect to the optical axis. To the contrary, in the Shimizu et al. patent, a parallel flat plate is tilted, to thereby correct for astigmatism and coma. Applicant submits that this presents a clear discrepancy between the teachings of these two citations. Namely, in the European document, correction of astigmatism has already been accomplished by means of the cylindrical lens itself. Further, that document does not even consider coma aberration. Applicant submits, therefore, that there is no incentive or motivation for one skilled in the art to introduce the teachings of the Shimizu et al. patent, that is, tilting an element for correcting astigmatism or coma, into the device in the European document, in which astigmatism has already been corrected. Notably, there is nothing further to be corrected in the device in that document.

For these reasons, Applicant submits that the European document and the Shimizu et al. patent may not properly be combined in the manner suggested in the Office Action.

The Matsugu et al. patent shows a proximity type exposure apparatus in which there is no projection system between a mask and a wafer. Although it might be construed that the Matsugu et al. patent suggests the use of a cylindrical lens for an optical system for detecting marks of the mask and the wafer, Applicant submits that the Matsugu et al. patent does not specifically teach or suggest a projection system for projecting a device pattern onto a wafer. In this regard, Applicant has amended independent claim 12 to more clearly define that the projection optical system in the projection system of the present invention is disposed between the device pattern

and the wafer, and that the optical element also is disposed between the device pattern and the wafer. Applicant submits that the cited art does not teach or suggest such features of the present invention.


For the foregoing reasons, Applicant submits that the present invention, as recited in independent claims 2 and 12, is patentably defined over the cited art, whether that art is taken individually or in combination.

Dependent claims 3-10, 13-17, 19 and 20 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of these dependent claims as requested.

Applicant further submits that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the rejections set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,



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APPENDIX A

IN THE CLAIMS

2. (Amended) An aberration changing optical system for changing an aberration, said optical system comprising:

an optical element having different refracting powers in two orthogonal directions or having a refracting power only in one direction, said optical element being rotatable about a rotational axis, which is an optical axis of said optical system, and being tiltable relative to the optical axis.

3. (Amended) An aberration changing optical system according to Claim [1 or] 2, further comprising a plurality of optical elements each being rotatable and tiltable, and wherein said optical elements are selectively used to change the aberration.

4. (Amended) An aberration changing optical system according to Claim [1 or] 2, further comprising a second optical element having at least one of a cylindrical surface and a toric surface, said optical element being rotatable about the optical axis of said optical system and tiltable relative to the optical axis, integrally with the first mentioned optical element, said second optical element further being tiltable in an opposite direction to the first-mentioned optical element.

5. (Amended) An aberration changing optical system according to Claim [1 or] 2, further comprising a parallel flat plate being rotatable about the optical axis of said optical system and tiltable relative to the optical axis, integrally with the optical element, said parallel flat plate further being tiltable in an opposite direction to said optical element.

6. (Amended) An aberration changing optical system according to [any one of Claims 1 - 2] Claim 2, wherein said optical element is mainly composed of a transparent material of one of quartz and fluorite.

7. (Amended) An aberration changing optical system according to [any one of Claims 1 - 2] Claim 2, wherein the or each surface of said optical element, having a refracting power, has a refractive power not greater than $3 \times 10^{-7} \text{ mm}^{-1}$.

8. (Amended) A projection system, comprising:
a projection optical system; and
an aberration changing optical system as recited in [any one of Claims 1 - 2] Claim 2, for correcting aberration produced in said projection optical system.

9. (Amended) A projection exposure apparatus, comprising:
an illumination system; and
a projection system for projecting a pattern of a mask onto a substrate in cooperation with said illumination system, said projection system including a projection optical

system and an aberration changing optical system, as recited in [any one of Claims 1 - 2] Claim 2, for correcting aberration produced in said projection optical system.

12. (Amended) A projection system for projecting a device pattern onto a wafer, said projection system comprising:

a projection optical system disposed between the device pattern and the wafer;

and

an optical element for correcting aberration produced in said projection optical system, said optical element having different refracting powers in two orthogonal directions or having a refracting power only in one direction, and said optical element being disposed between the device pattern and the wafer and being inclined with respect to an optical axis.

14. (Amended) A projection system according to Claim [11 or] 12, further comprising a second optical element having at least one of a cylindrical surface and a toric surface, said second optical element being inclined with respect to the optical axis and in an opposite direction to the first-mentioned optical element.

15. (Amended) A projection system according to Claim [11 or] 12, further comprising a parallel flat plate being inclined with respect to the optical axis and in an opposite direction to said optical element.

16. (Amended) A projection system according to [any one of Claims 11 - 12] Claim 12, wherein said optical element is mainly composed of a transparent material of one of quartz and fluorite.

17. (Amended) A projection system according to [any one of Claims 11 - 12] Claim 12, wherein the or each surface of said optical element, having a refracting power, has a refractive power not greater than $3 \times 10^{-7} \text{ mm}^{-1}$.

19. (Amended) A projection exposure apparatus, comprising:
an illumination system; and
a projection system for projecting a pattern of a mask onto a substrate in cooperation with said illumination system, said projection system including a projection optical system and an optical system, as recited in [any one of Claims 11 - 12] Claim 12, for correcting aberration produced in said projection optical system.